

# Neo-Sense: a real time data processing & acquisition unit for monitoring neonatal ECG in the delivery room



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## Introduction

Heart rate is the most important indicator of the clinical status of a newborn. It should be assessed as quickly and accurately as possible. Infants needing resuscitation require continuous and real-time heart rate monitoring, aiming to lower the incident of long-term consequences of poor adaptation after birth such as brain damage or death.

The objective of this research is to design a solution to bring high resolution, real time ECG data to the delivery room using non-contact electric potential sensors [EPS]. Rapid and accurate acquisition of the neo-natal heart and breathing rates, as well as the facility for unobtrusive, autonomous & continual monitoring during intervention, can inform clinical intervention leading to better survivability and quality of life.



## Current methods



### Pulse oximetry

- up to 2 minutes to get heart rate reading
- proper placement required
- underestimates HR initially & cannot measure HR < 60s



### Ag-AgCl electrodes

- time to attach sensor
- requires interface gel/paste which can irritate or damage skin



### Auscultation

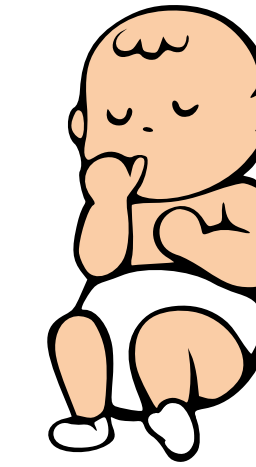
- relies on the experience of the attending staff at birth
- no data recording
- resuscitation must be interrupted to acquire HR



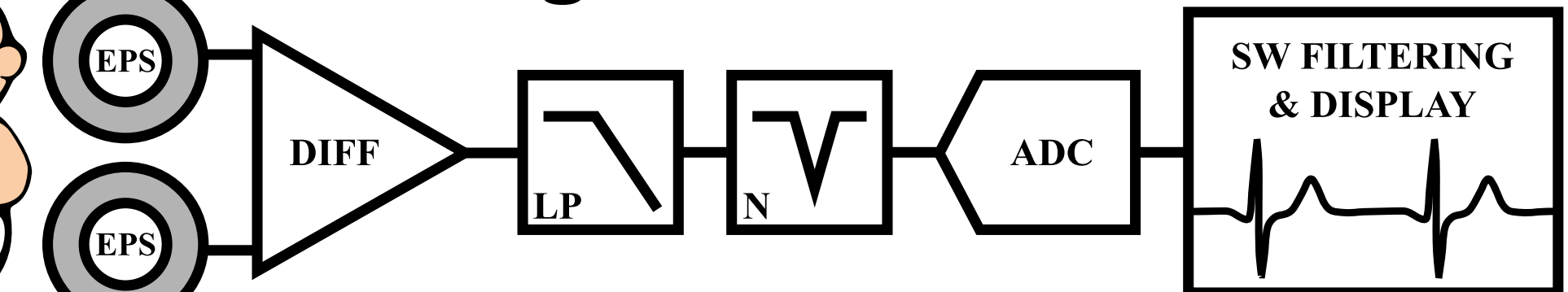
### Handheld doppler

- application requires trained member of staff
- requires interface gel/paste which can irritate or damage skin

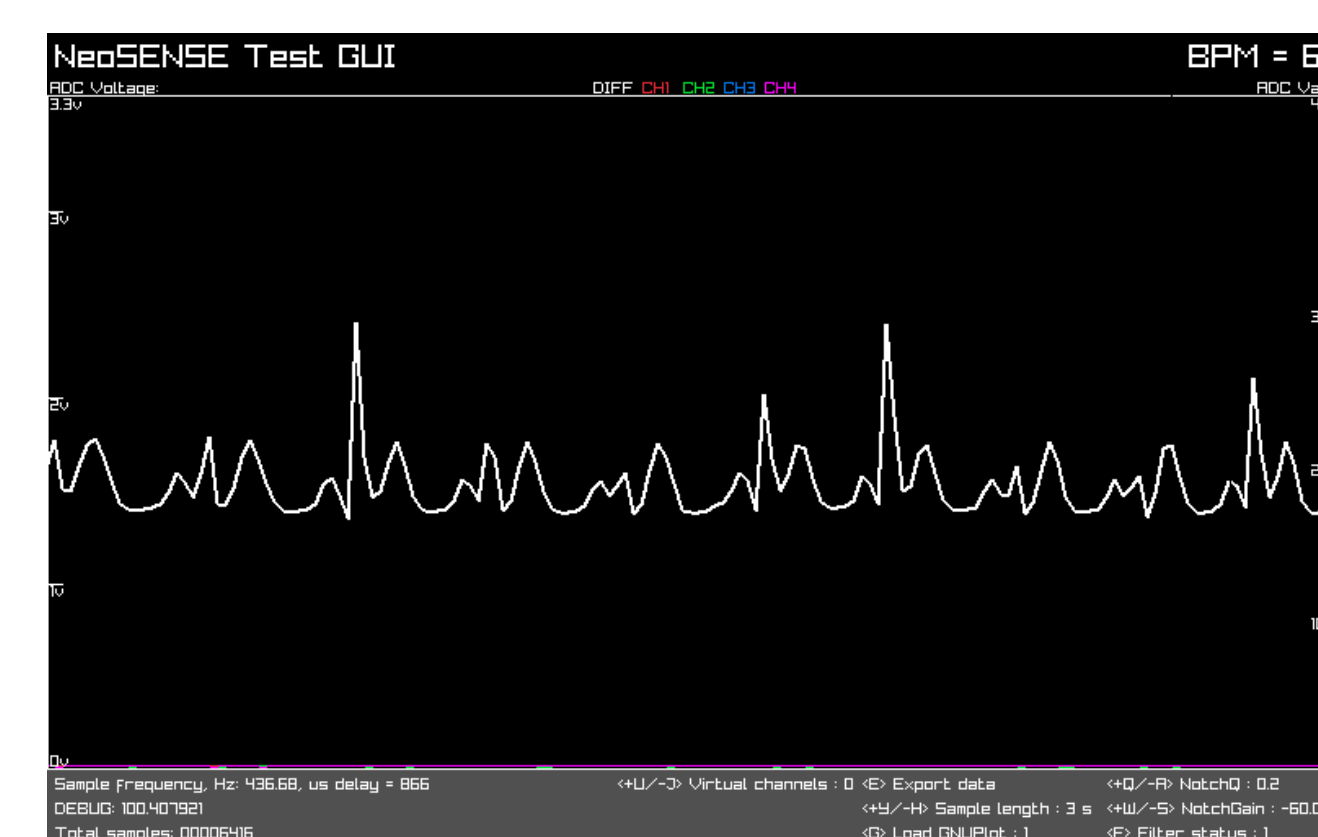
## Results



### Signal Path:

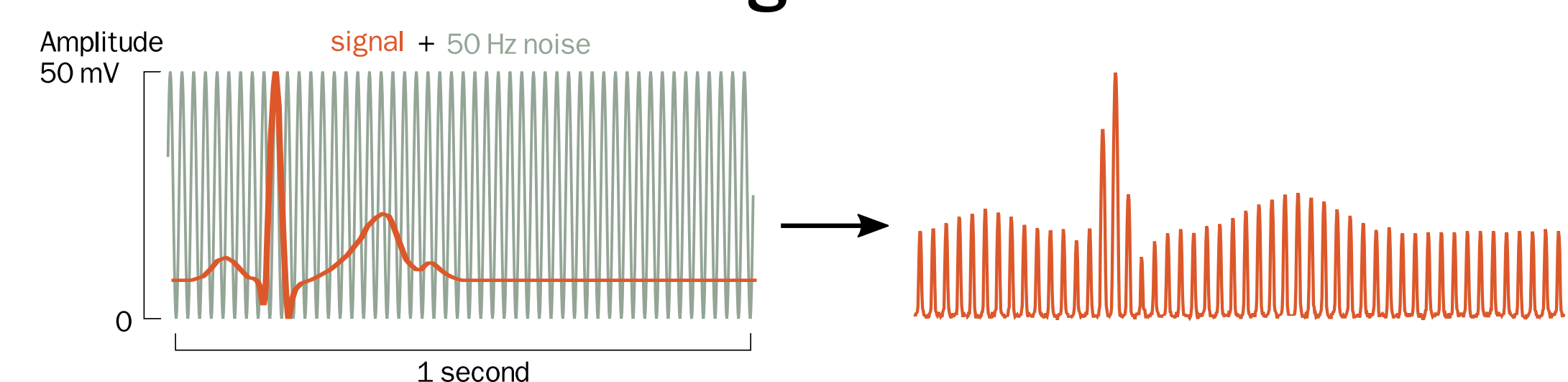


### Interface:

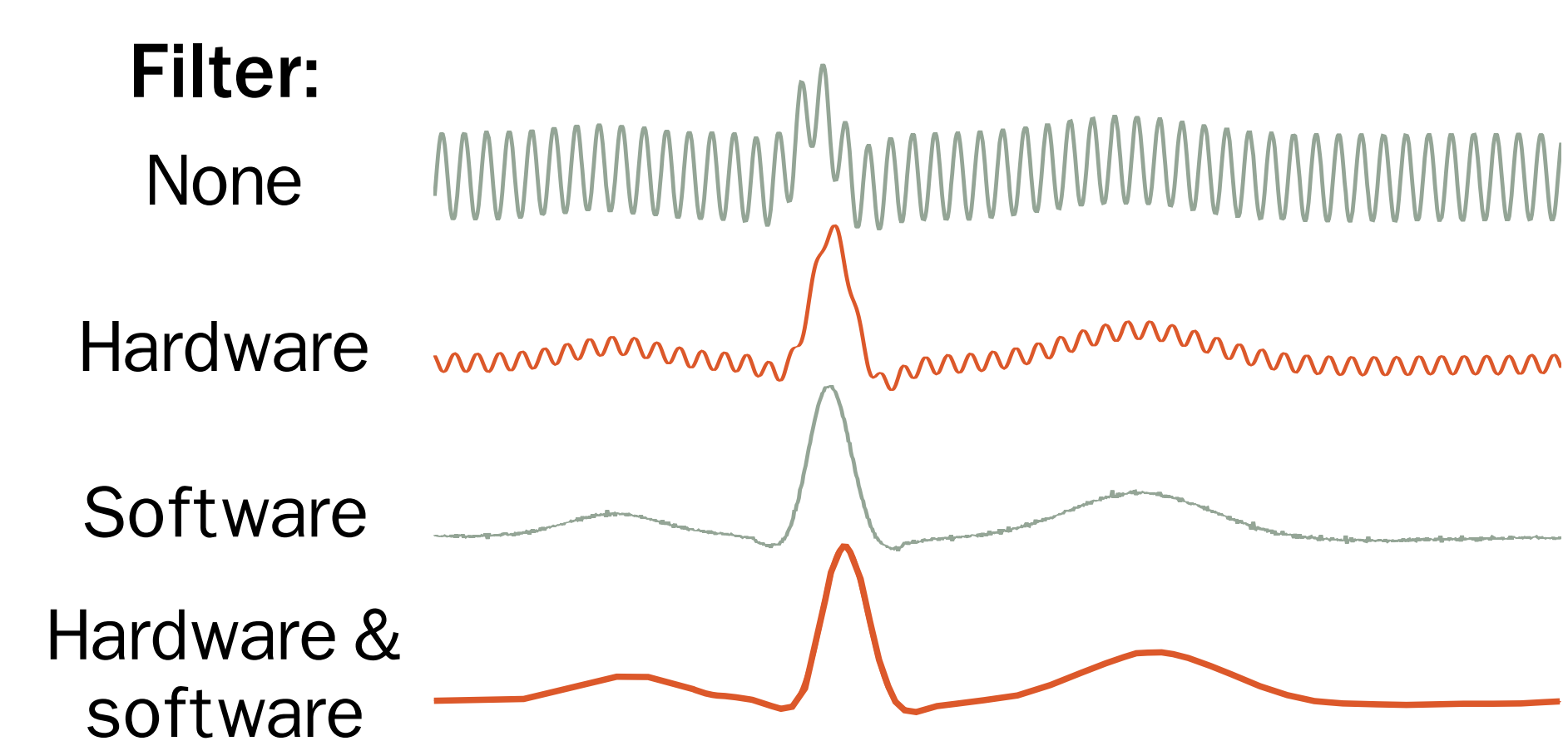


- Software interface based on C++ code
- Runs from Linux shell
- Graphics rendered in OpenGL
- Hardware & software filtering stages
- High precision instrumentation amplifiers
- 12 bit discrete ADC

### Signal:

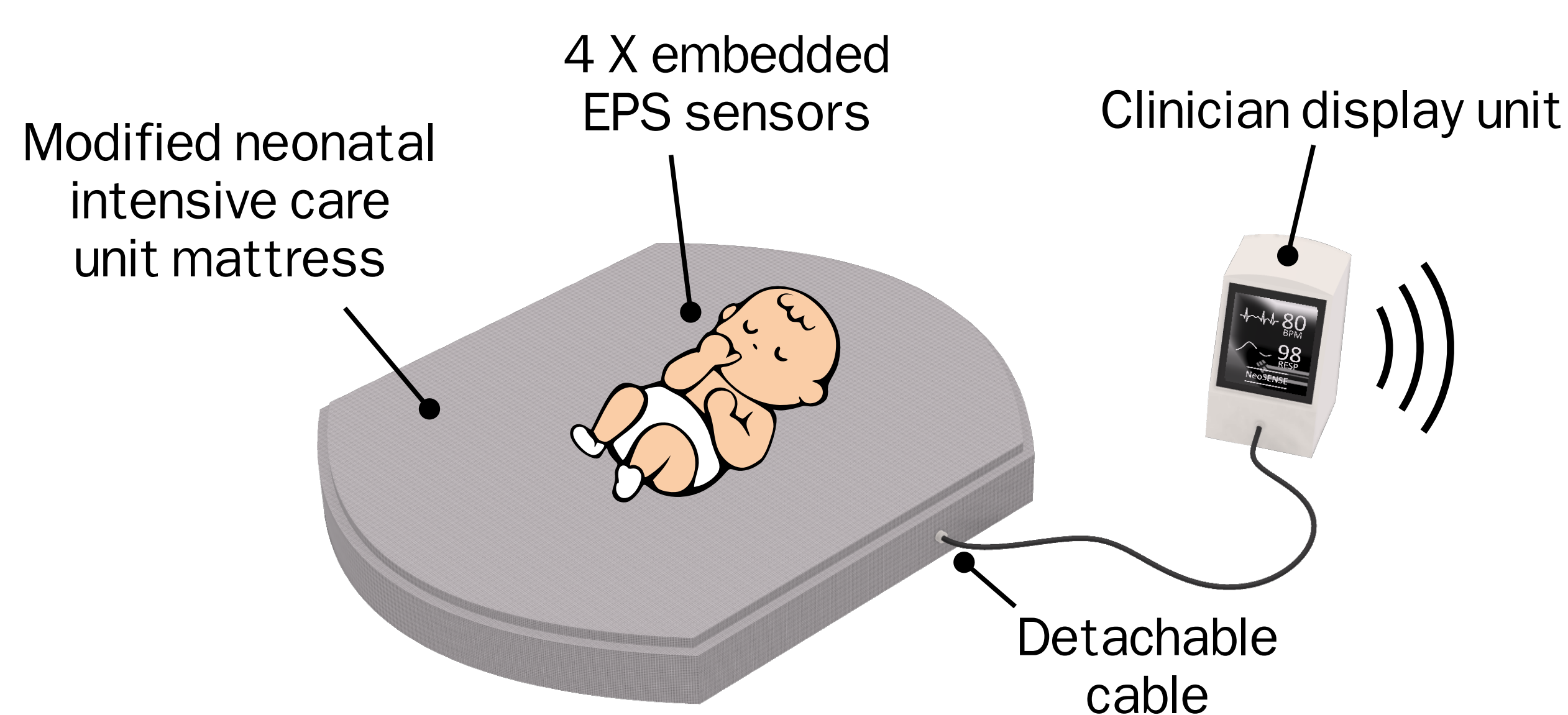


### Output:



## Neo-Sense mattress

The Neo-Sense mattress is capable of rapidly extracting heart rate and respiration data from a newborn in real time, without the need for attaching external sensors and without impeding resuscitation procedures.



- Design based on a qualitative study<sup>[1]</sup>
- Heart rate & respiration acquired in less than 30s<sup>[2]</sup>
- Non contact EPS sensors<sup>[3]</sup>
- High signal to noise ECG signals

## Future Directions

Planned improvements and developments for the system include:

- Up-scaling to multiple sensors
- Textile electrodes and flexible electronics
- Integration of additional metrics as required by clinicians

Regulatory approvals are in progress, and an expanded clinical trial will be performed in the delivery room at the Royal Alexandra Children's Hospital with a cohort of 30 babies.

## Conclusions

The prototype Neo-Sense mattress uses novel non-contact electric potential sensors, which overcome many of the limitations of traditional heart rate monitoring methods.

The real time data processing and acquisition unit demonstrates the capacity for embedded portable neo-natal ECG recording in the delivery room with effective noise filtering and bio-signal display.

## References

- [1] Anton O, et. al. Heart Rate Monitoring in Newborn Babies: A Systematic Review. Neonatology. Switzerland: (c) 2019 S. Karger AG, Basel.; 2019. p. 1-12.
- [2] Aviles-Espinosa R, et al. Neo-SENSE: a non-invasive smart sensing mattress for cardiac monitoring of babies, SAS IEEE Conference 2019.
- [3] R. Prance and C. Harland, EPS Patent US8264247B2 (2012).